Recent Results on Interactions between Deep Convection and Stratiform Clouds

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CERES Science Team, September 2003

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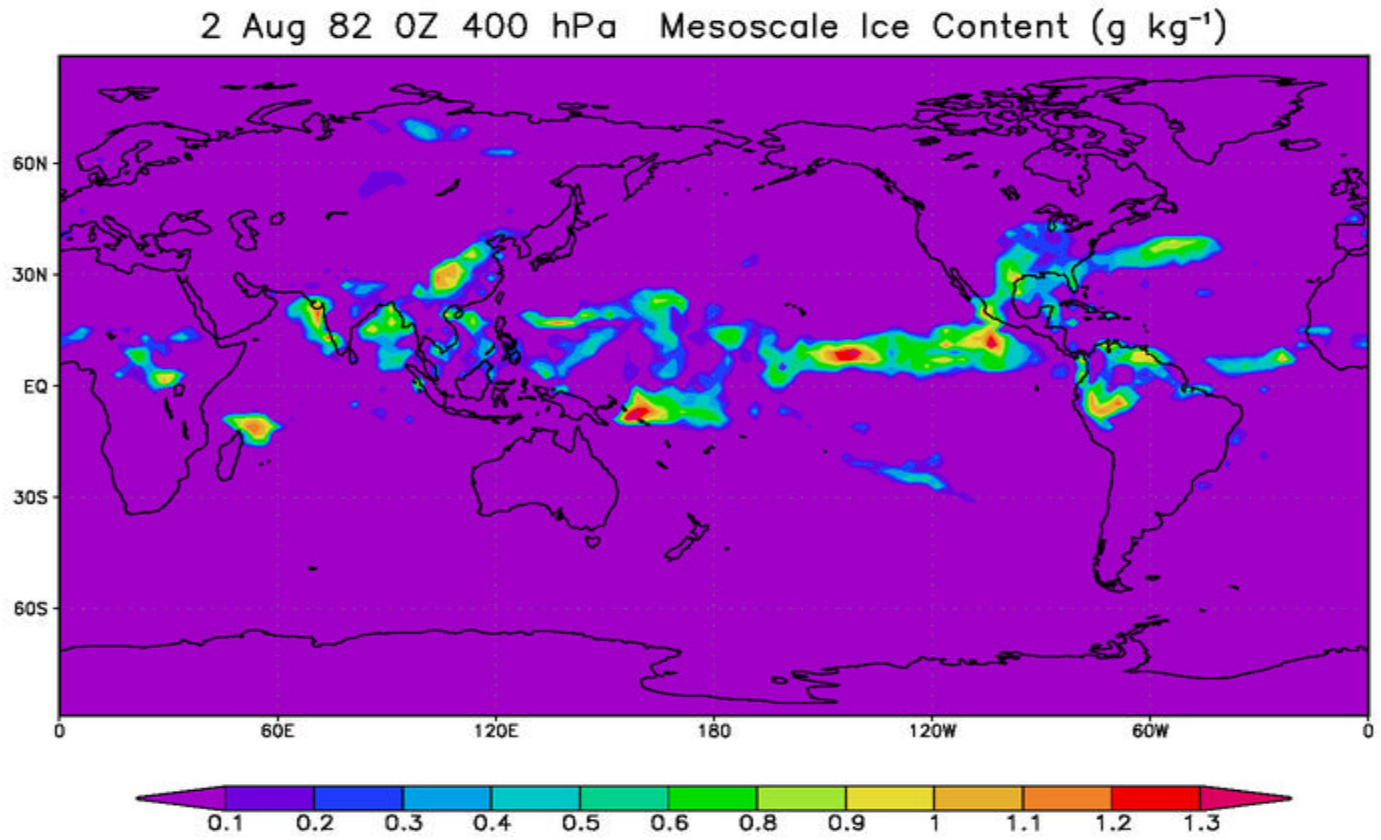
Recent Results

- FACE (Florida Area Cirrus Experiment) results on dynamics and microphysics of mesoscale anvils compare favorably with parameterized values from Donner deep convection in GFDL AM2
- Magnitude of SWCF greater in 3D than 2D simulations with WRF



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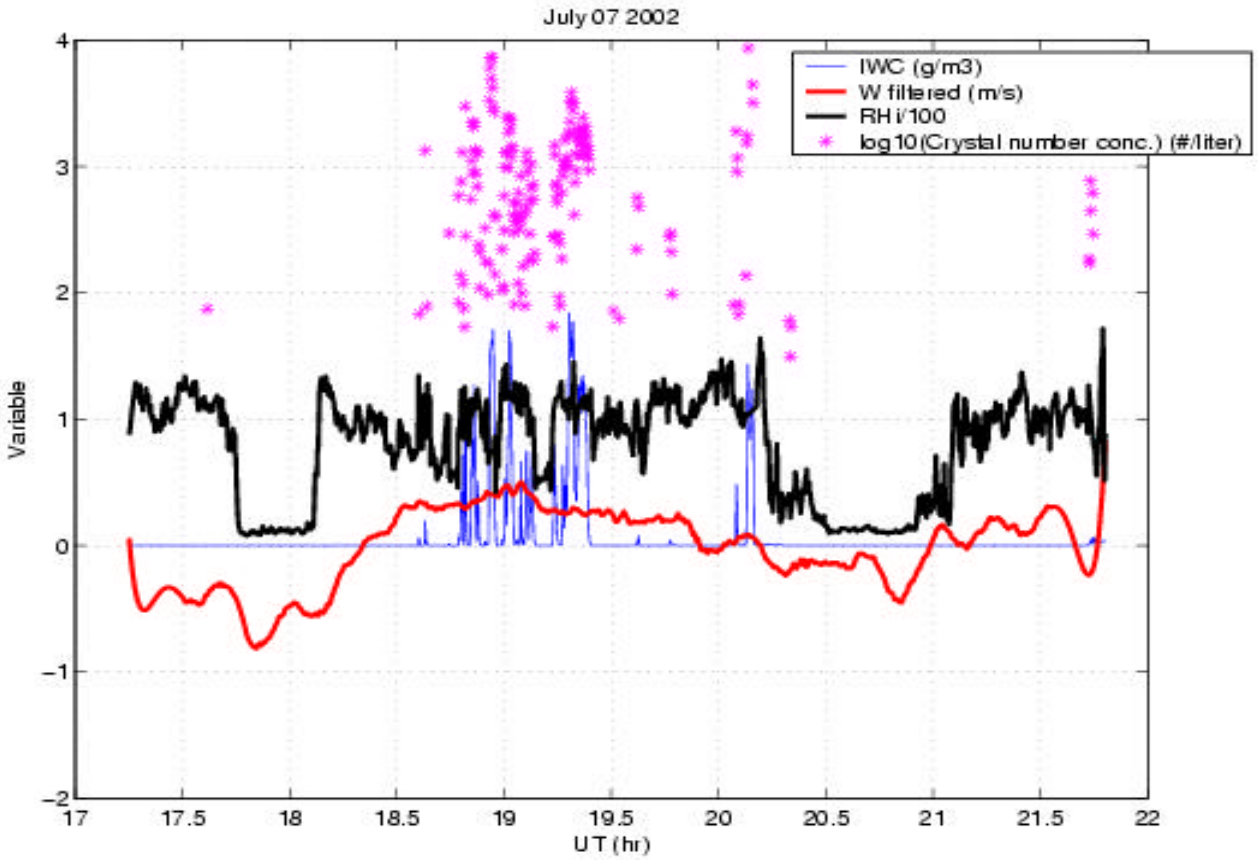
FACE Aircraft Observations



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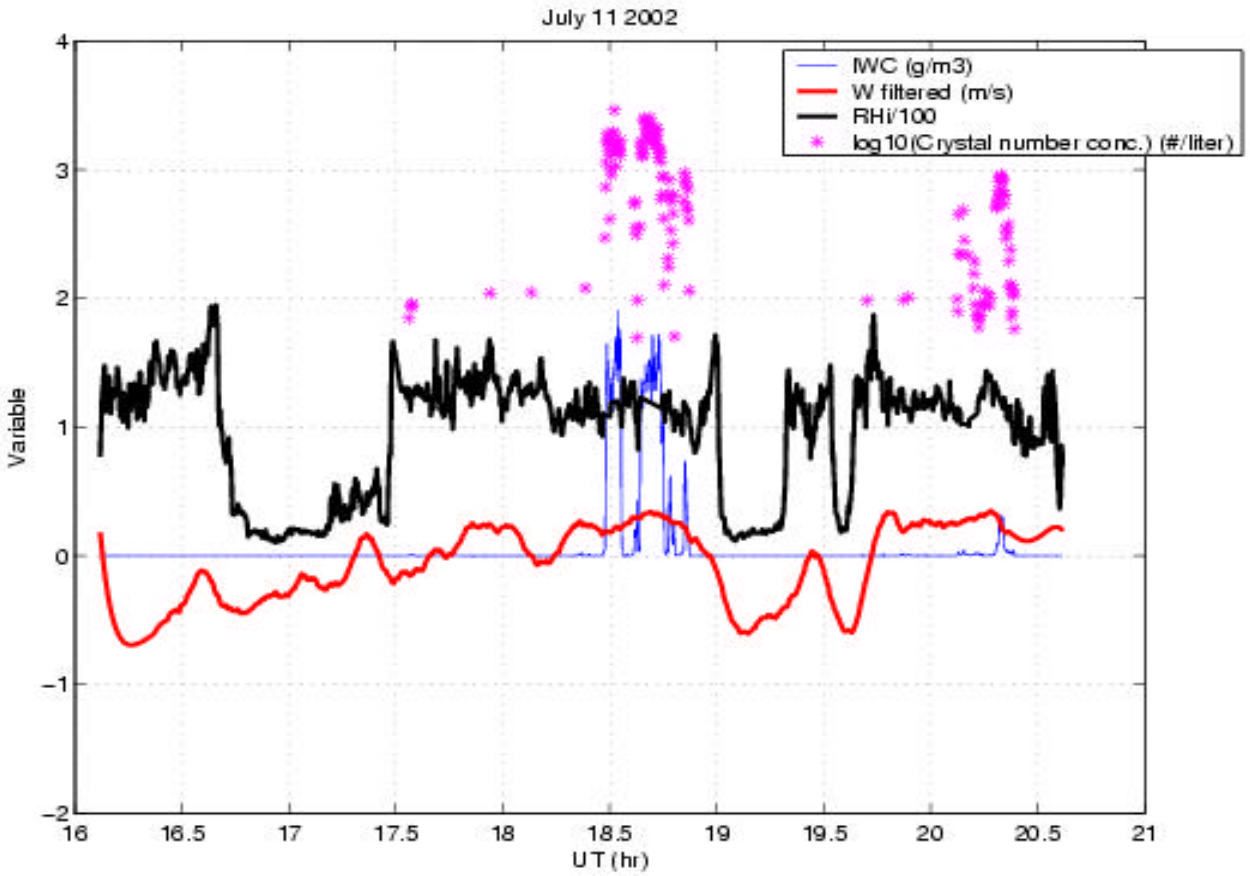
FACE Aircraft Observations



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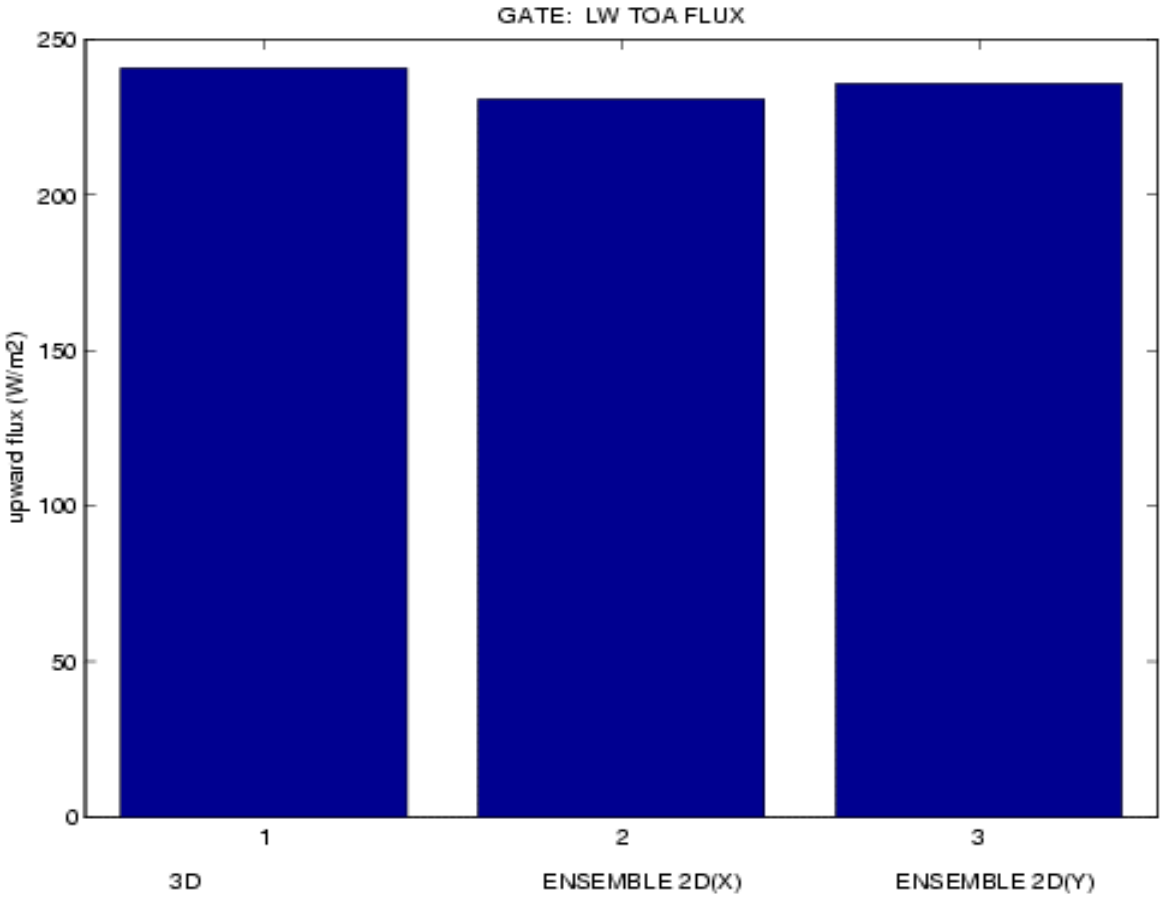

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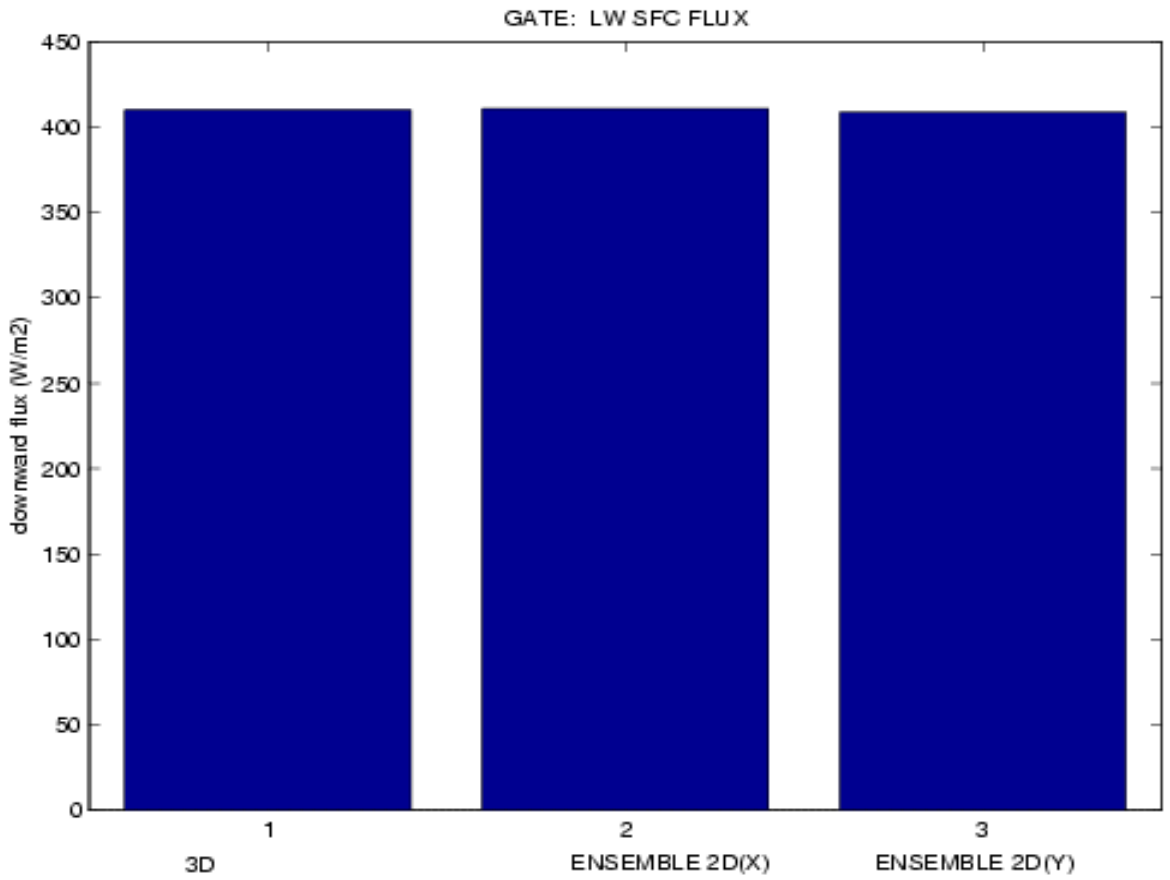

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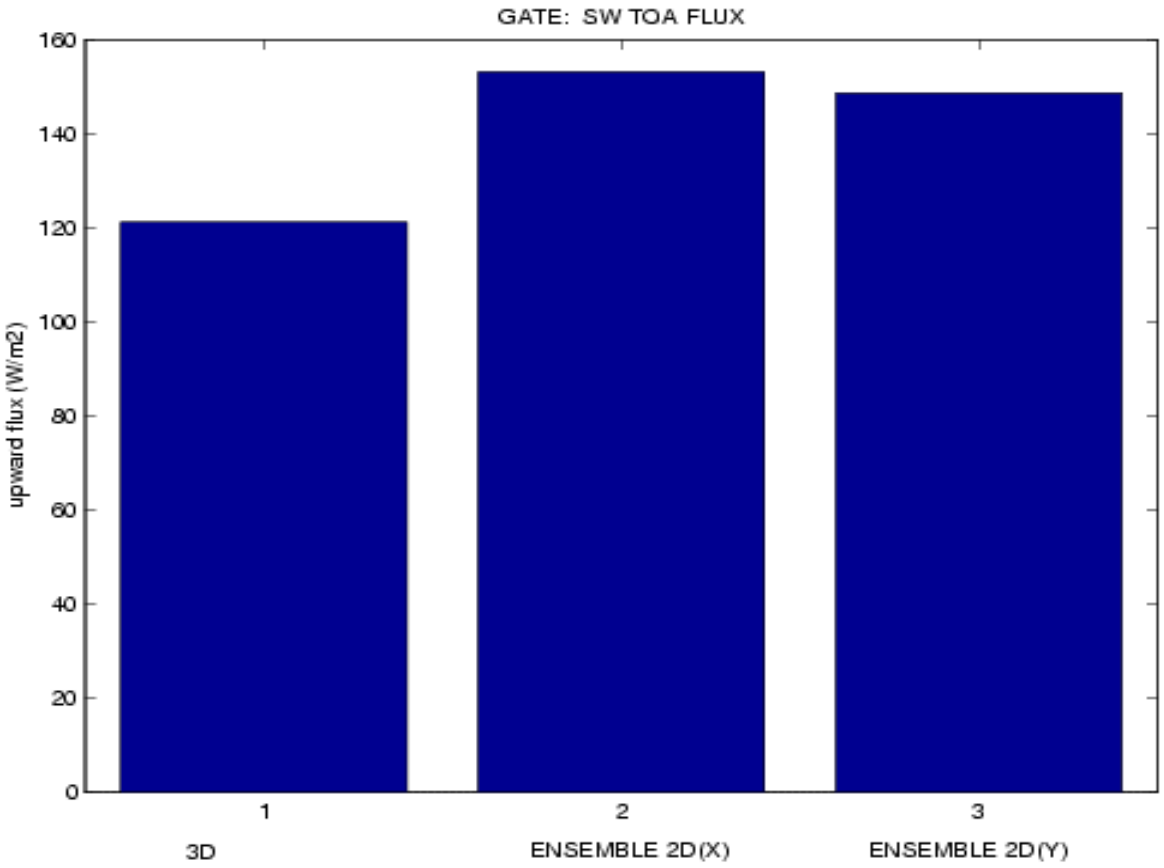

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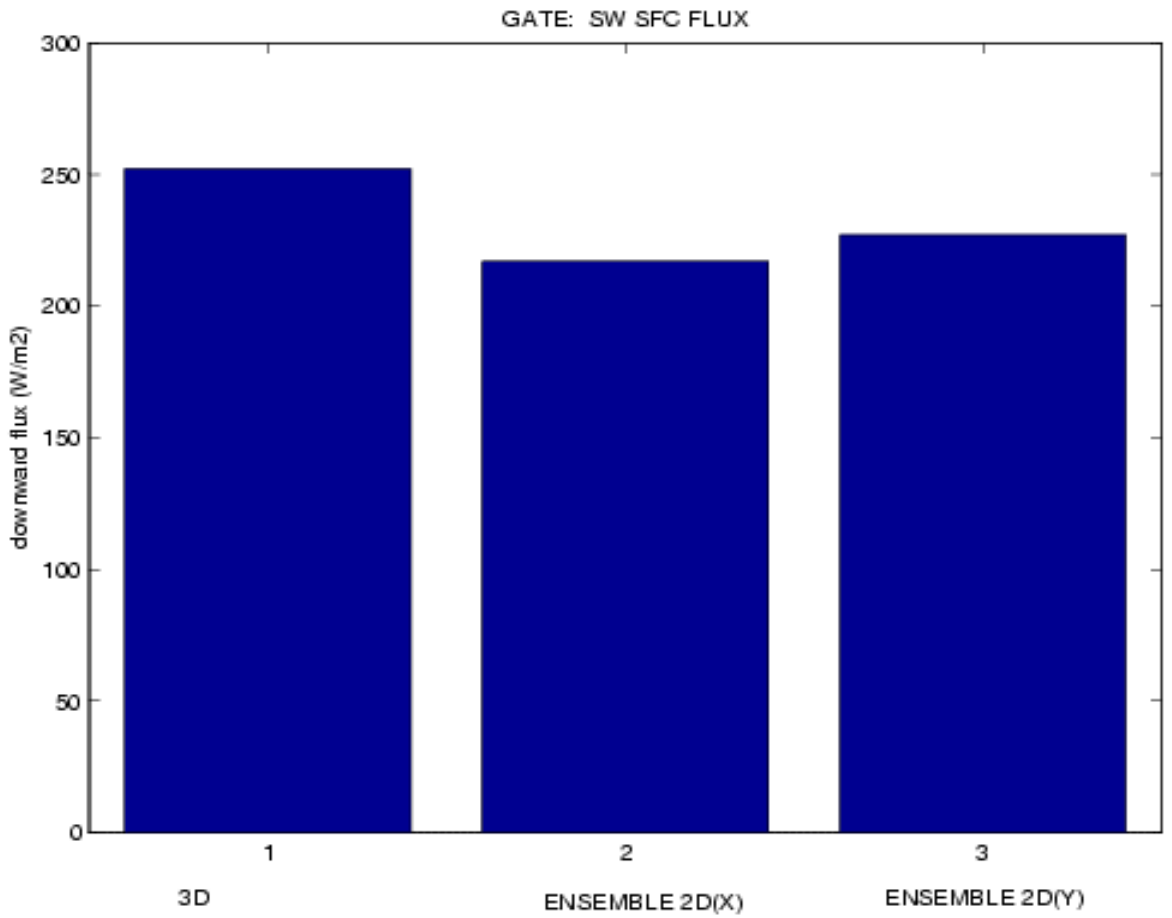

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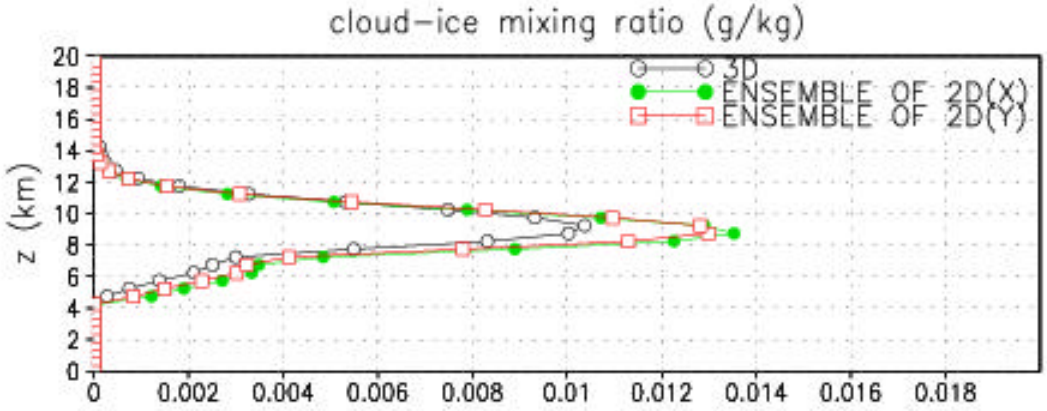
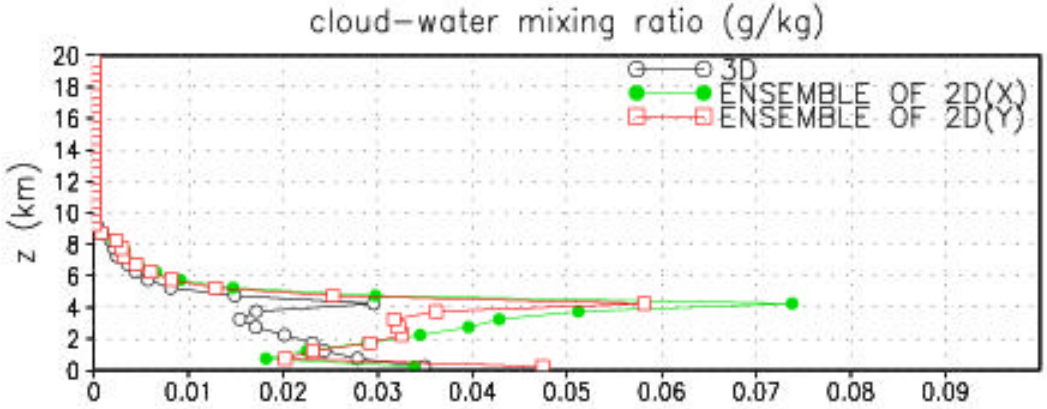
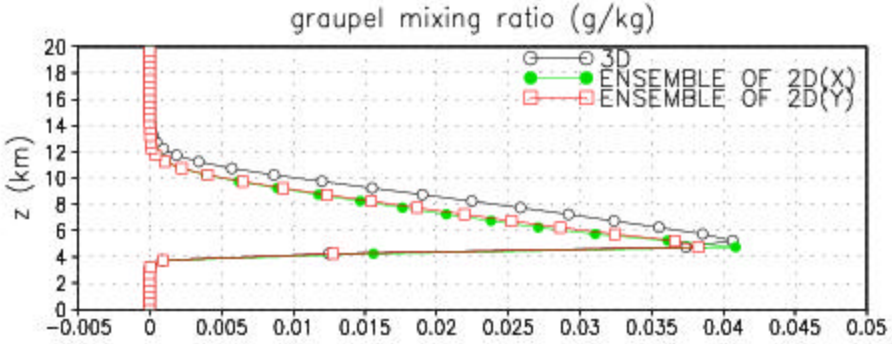
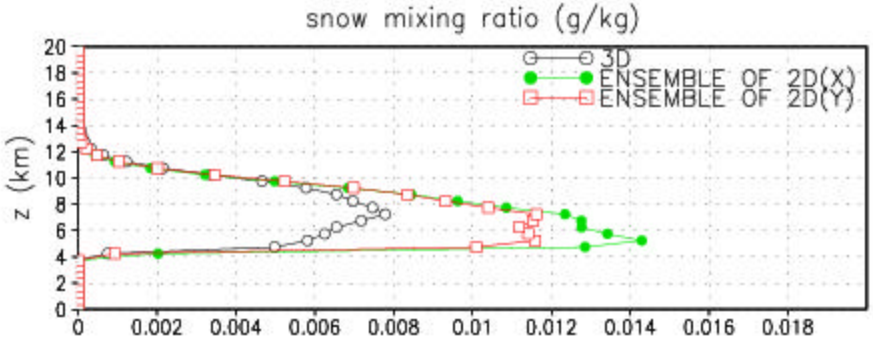
GATE WHOLE DOMAIN – Unconditional average

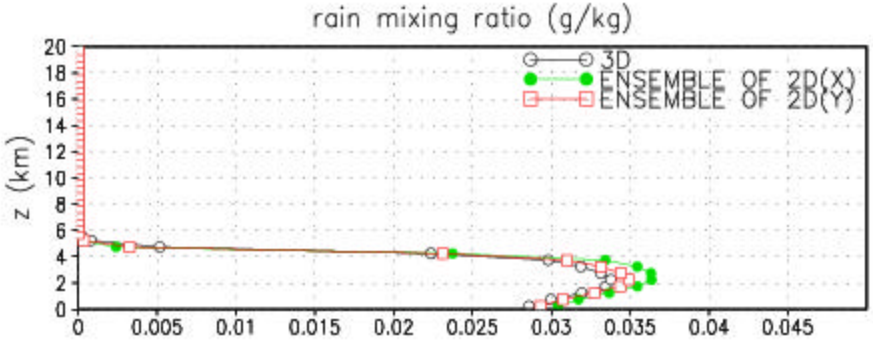




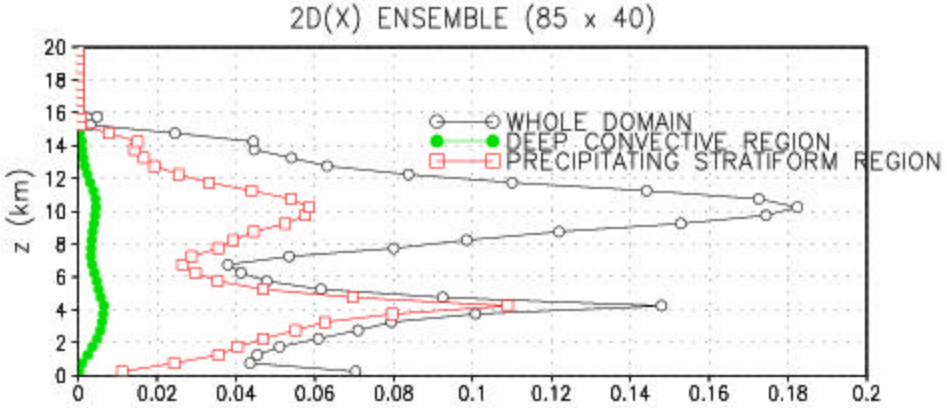
GATE WHOLE DOMAIN – Unconditional average

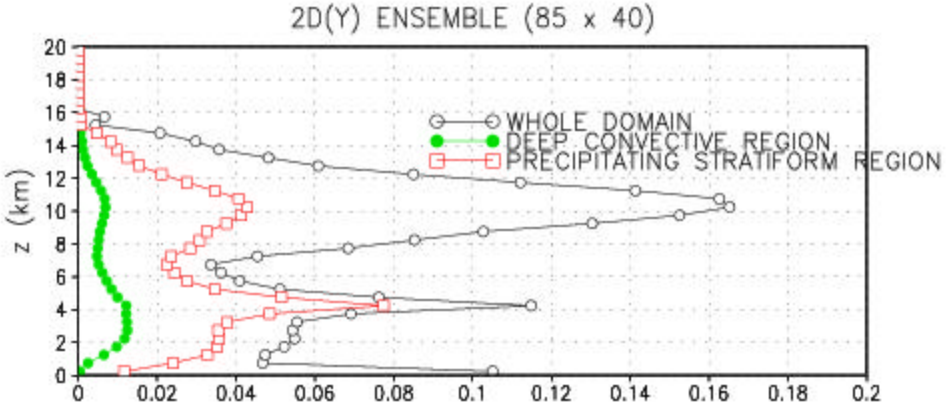


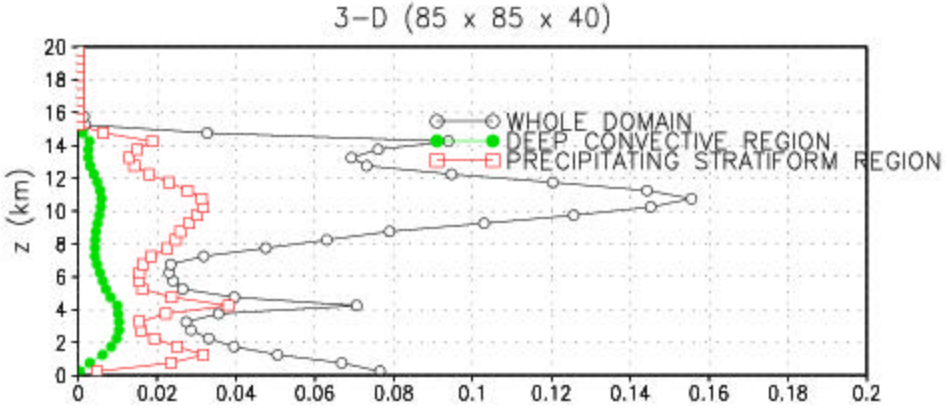


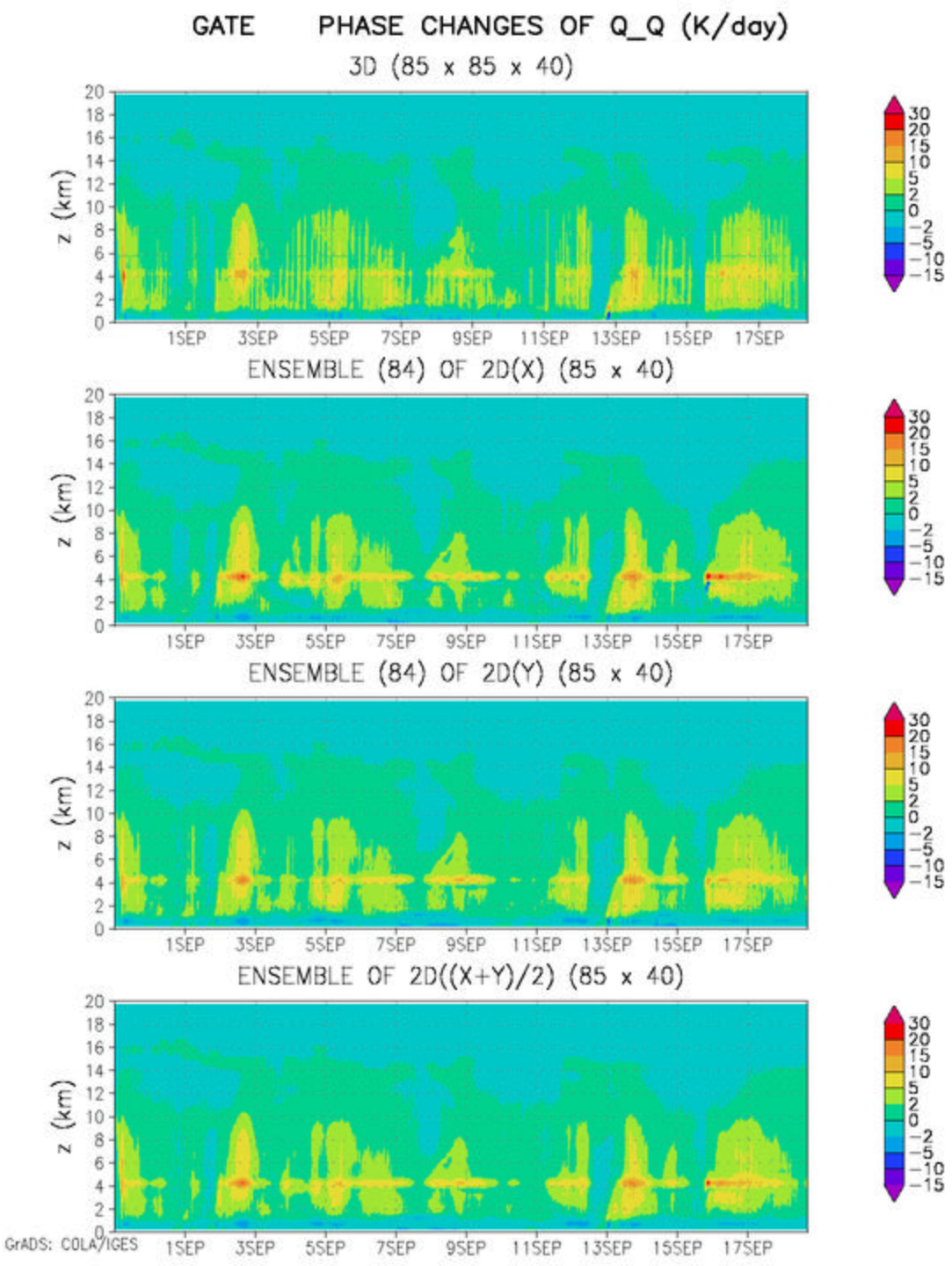


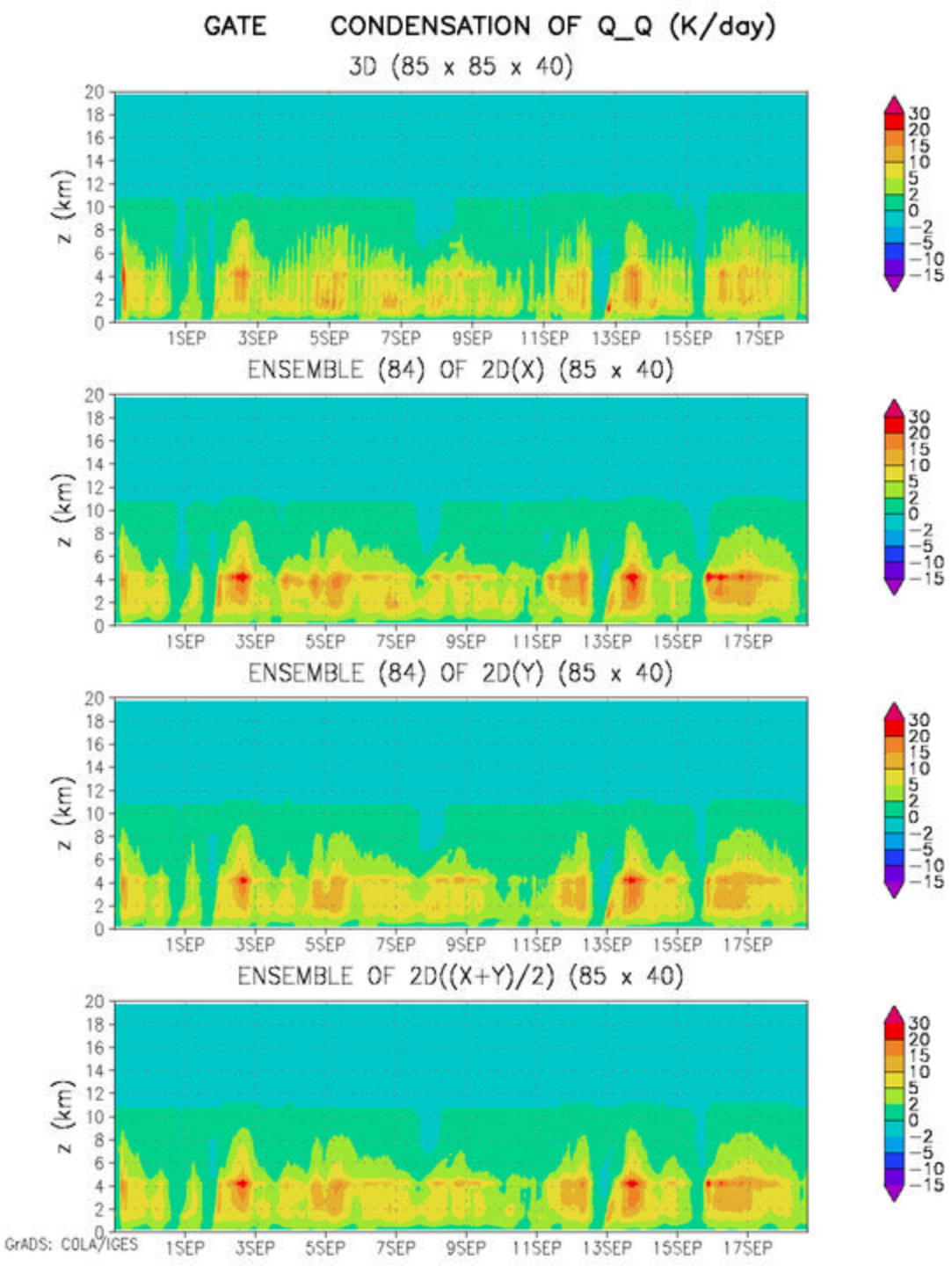
GATE CLOUD FRACTION



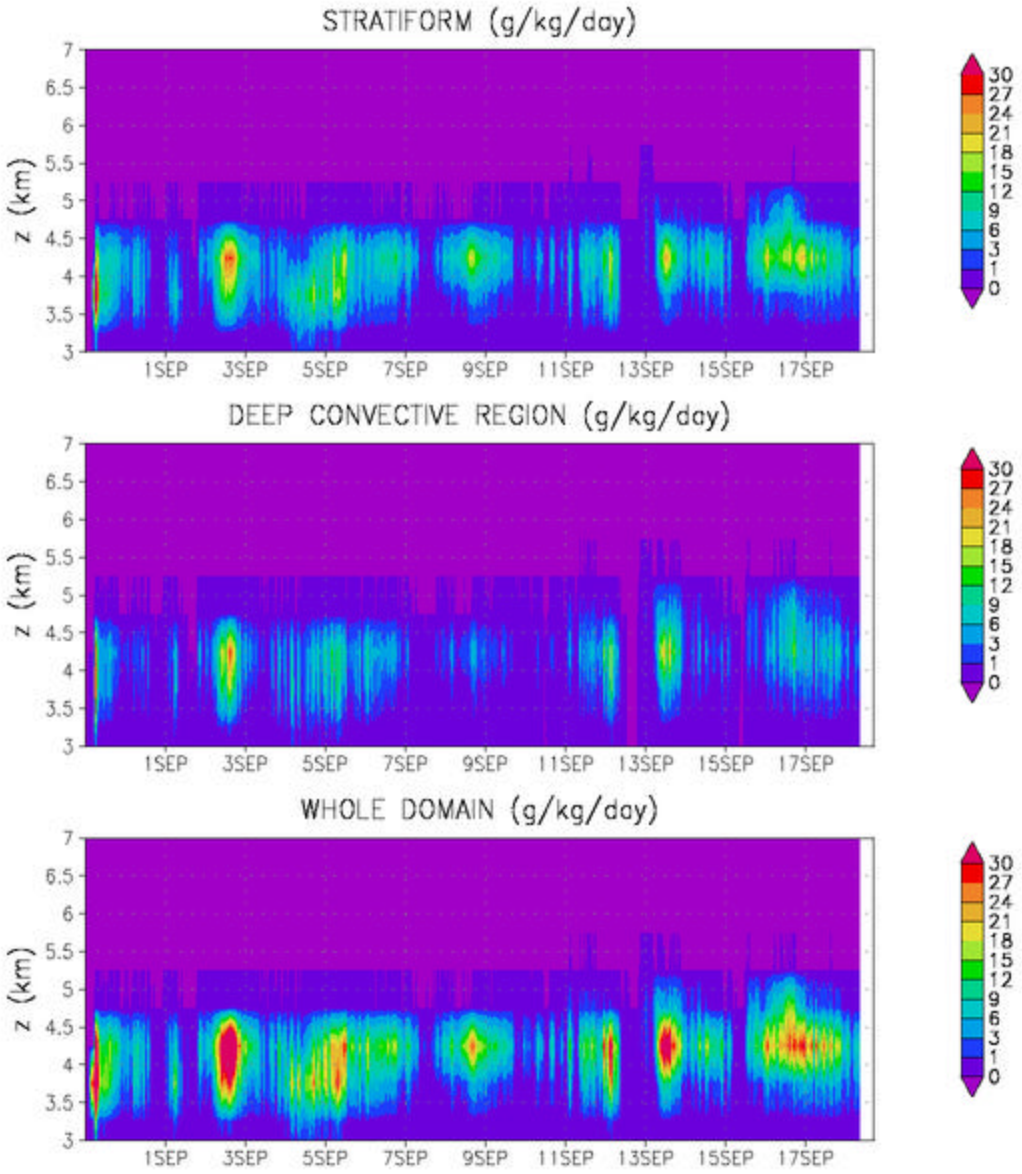




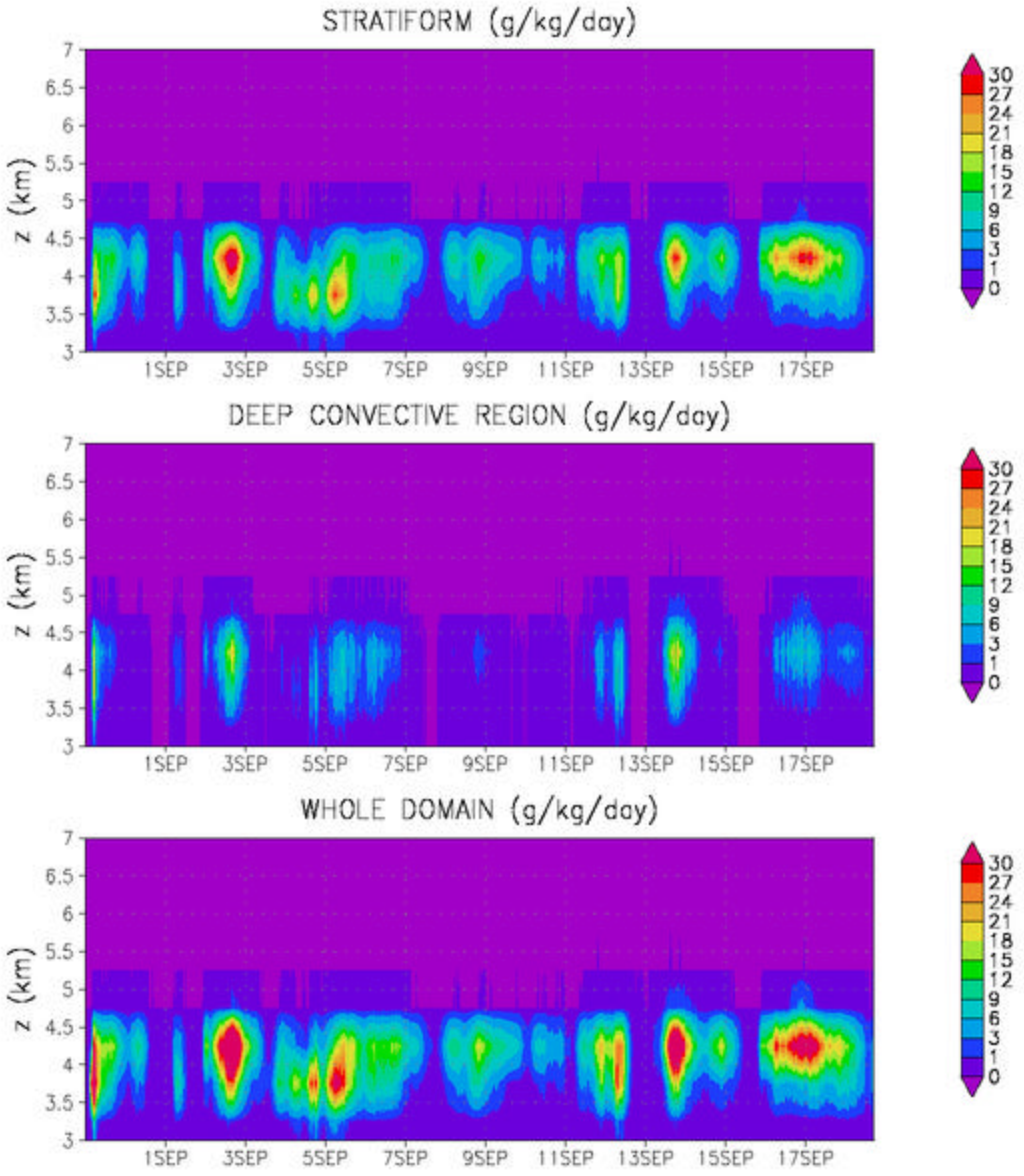

GATE PHASE CHANGES OF Q_Q (K/day)
3D (85 x 85 x 40)
ENSEMBLE (84) OF 2D(X) (85 x 40)
ENSEMBLE (84) OF 2D(Y) (85 x 40)
ENSEMBLE OF 2D((X+Y)/2) (85 x 40)
z (km)
0 2 4 6 8 10 12 14 16 18 20
1SEP 3SEP 5SEP 7SEP 9SEP 11SEP 13SEP 15SEP 17SEP
30 20 15 10 5 2 0 -2 -5 -10 -15
GrADS: COLA/IGES

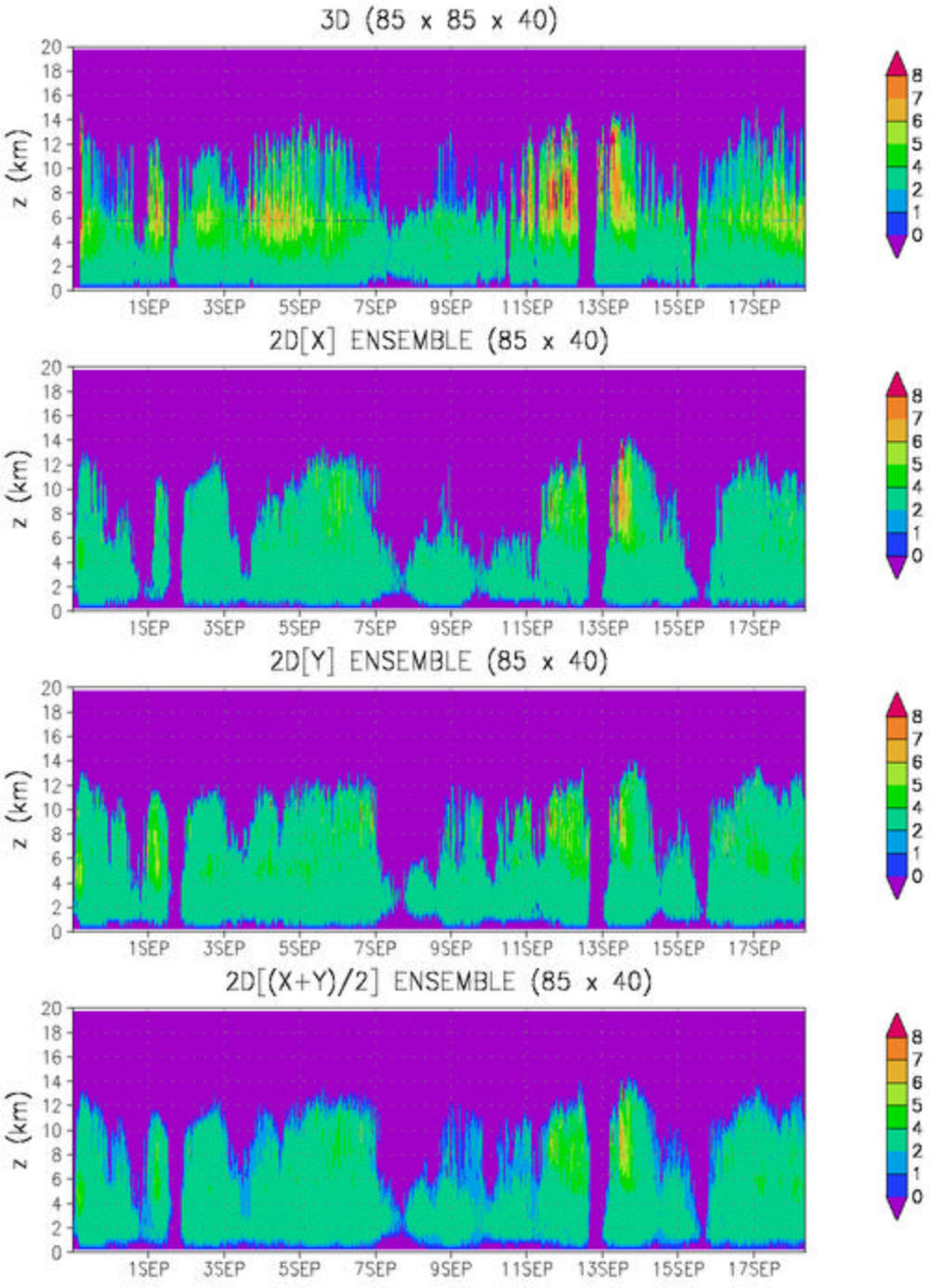

GATE CONDENSATION OF Q_Q (K/day)
3D (85 x 85 x 40)
ENSEMBLE (84) OF 2D(X) (85 x 40)
ENSEMBLE (84) OF 2D(Y) (85 x 40)
ENSEMBLE OF 2D((X+Y)/2) (85 x 40)
z (km)
0 2 4 6 8 10 12 14 16 18 20
1SEP 3SEP 5SEP 7SEP 9SEP 11SEP 13SEP 15SEP 17SEP
30 20 15 10 5 2 0 -2 -5 -10 -15
GrADS: COLA/IGES

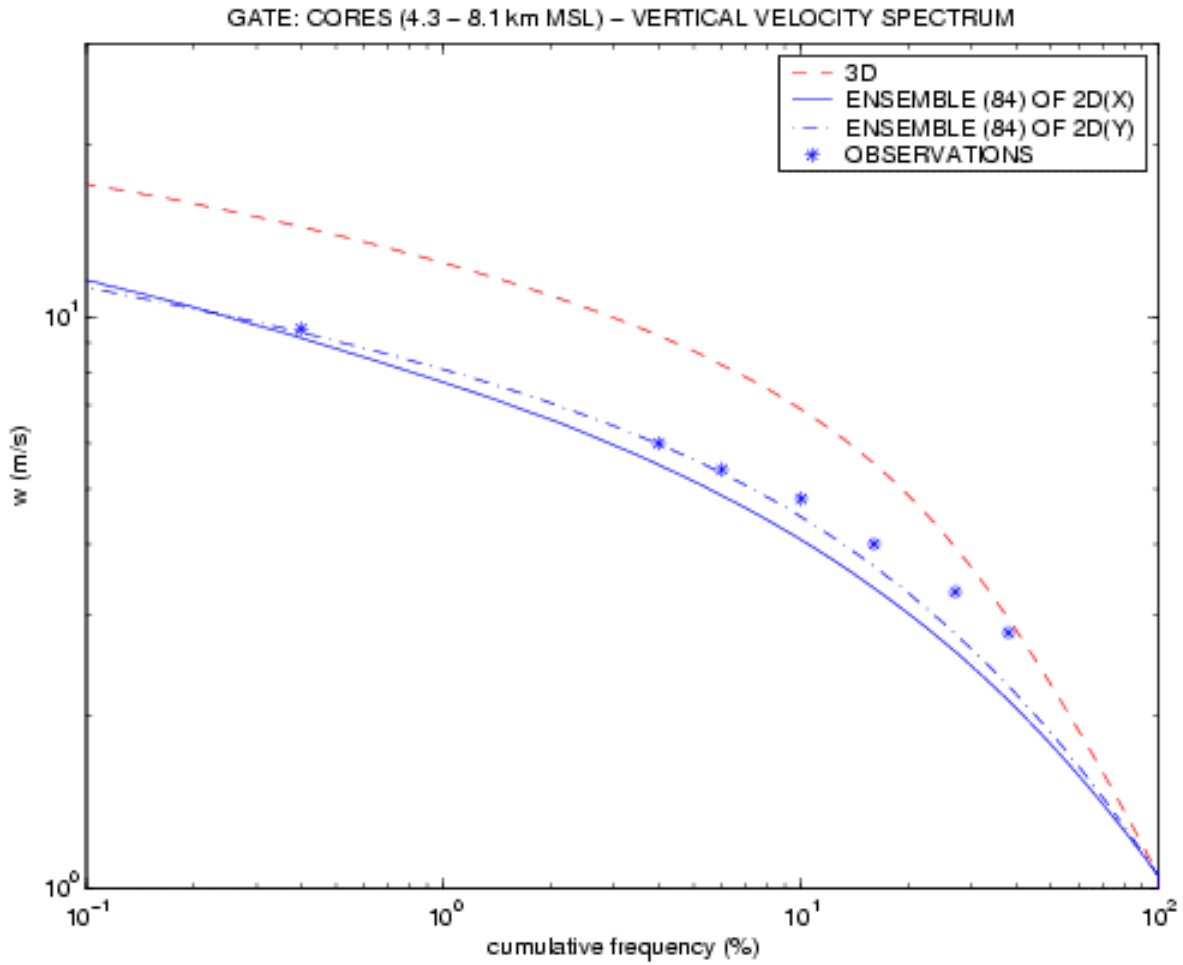
GATE – 3D MELTING RATES (unconditional ave)



2D GATE MELTING RATES (unconditional ave)




GATE ASCENT (m/s): DCR (> 2 m/s, > 0.1 g/kg)
3D (85 x 85 x 40)
2D[X] ENSEMBLE (85 x 40)
2D[Y] ENSEMBLE (85 x 40)
2D[(X+Y)/2] ENSEMBLE (85 x 40)
z (km)
0 2 4 6 8 10 12 14 16 18 20
1SEP 3SEP 5SEP 7SEP 9SEP 11SEP 13SEP 15SEP 17SEP
8 7 6 5 4 2 1 0



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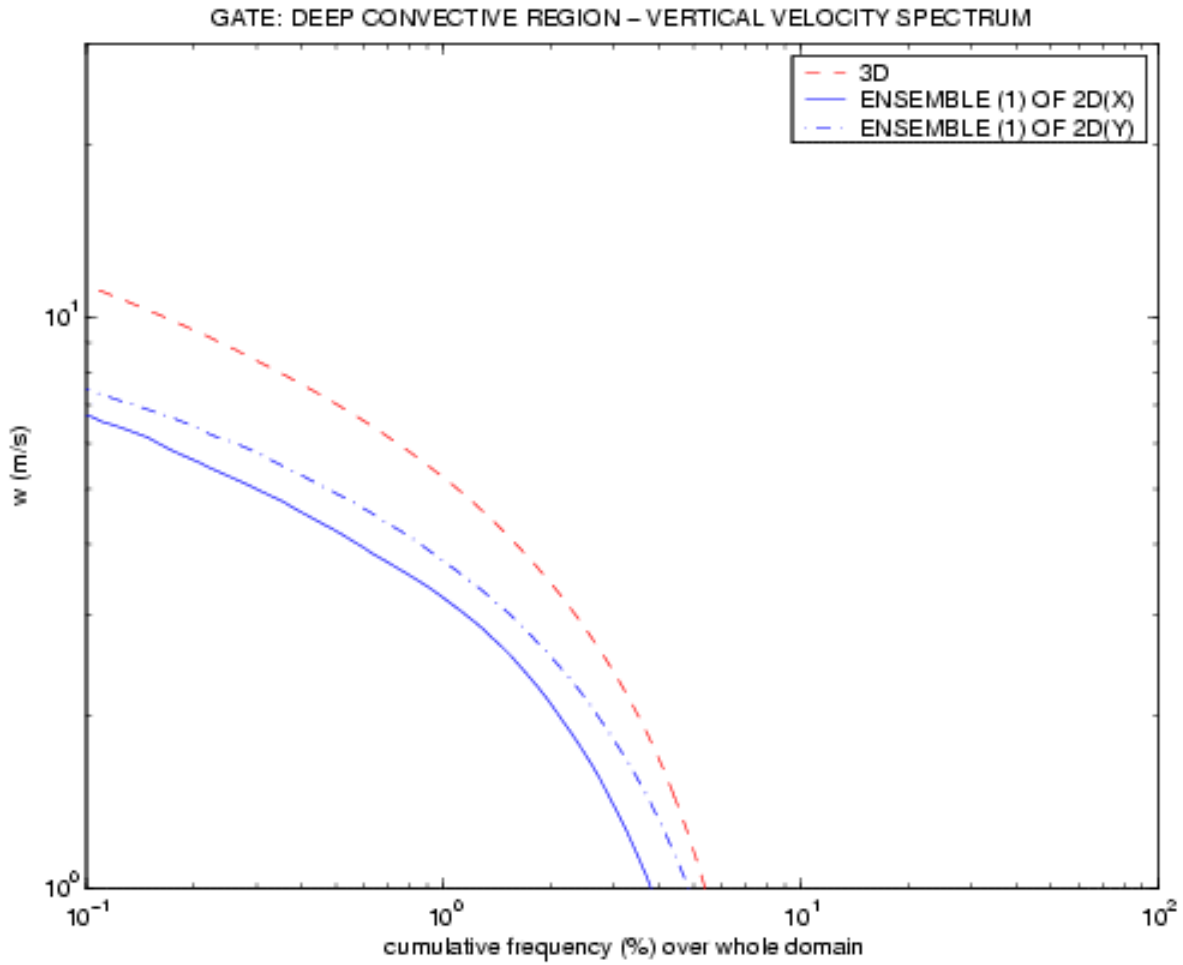

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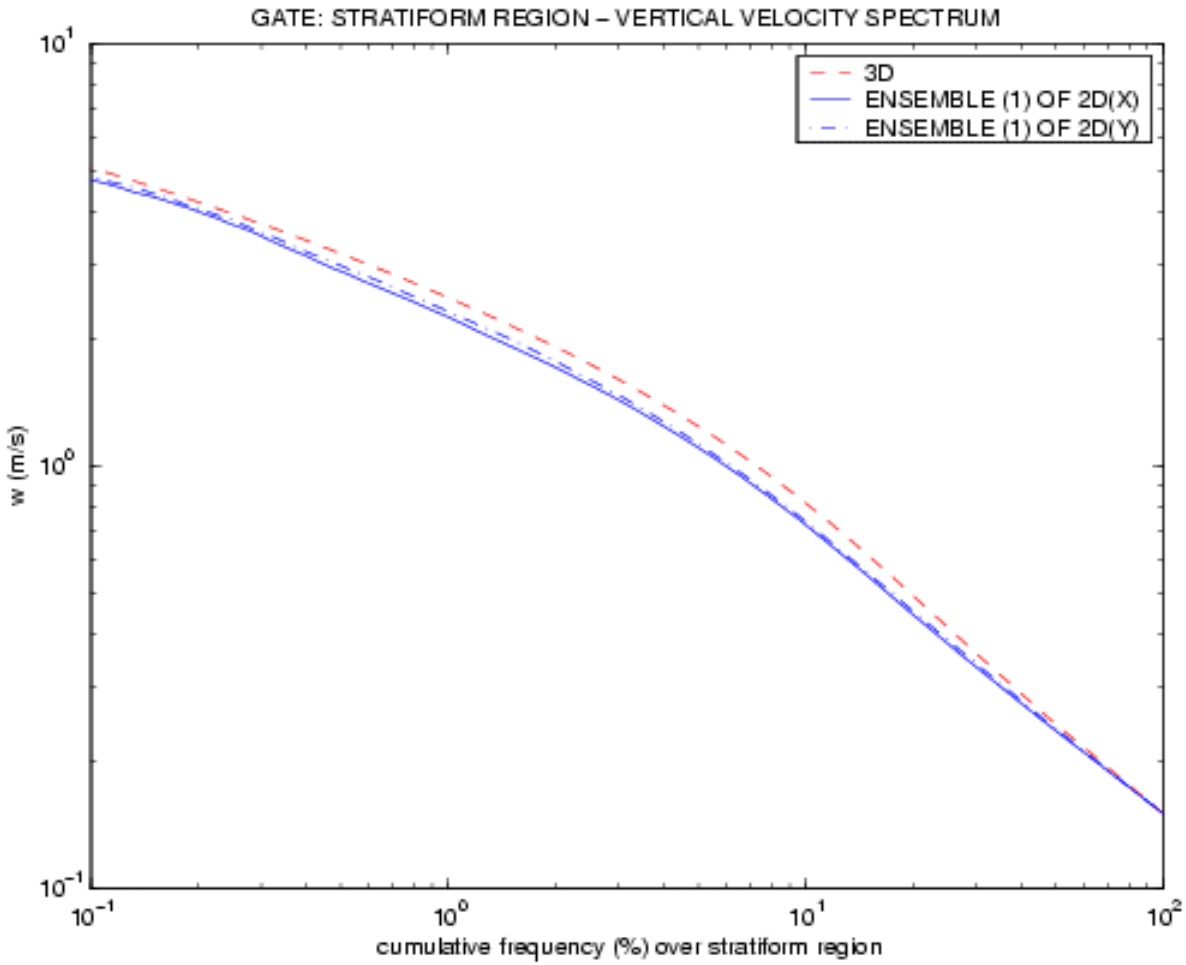

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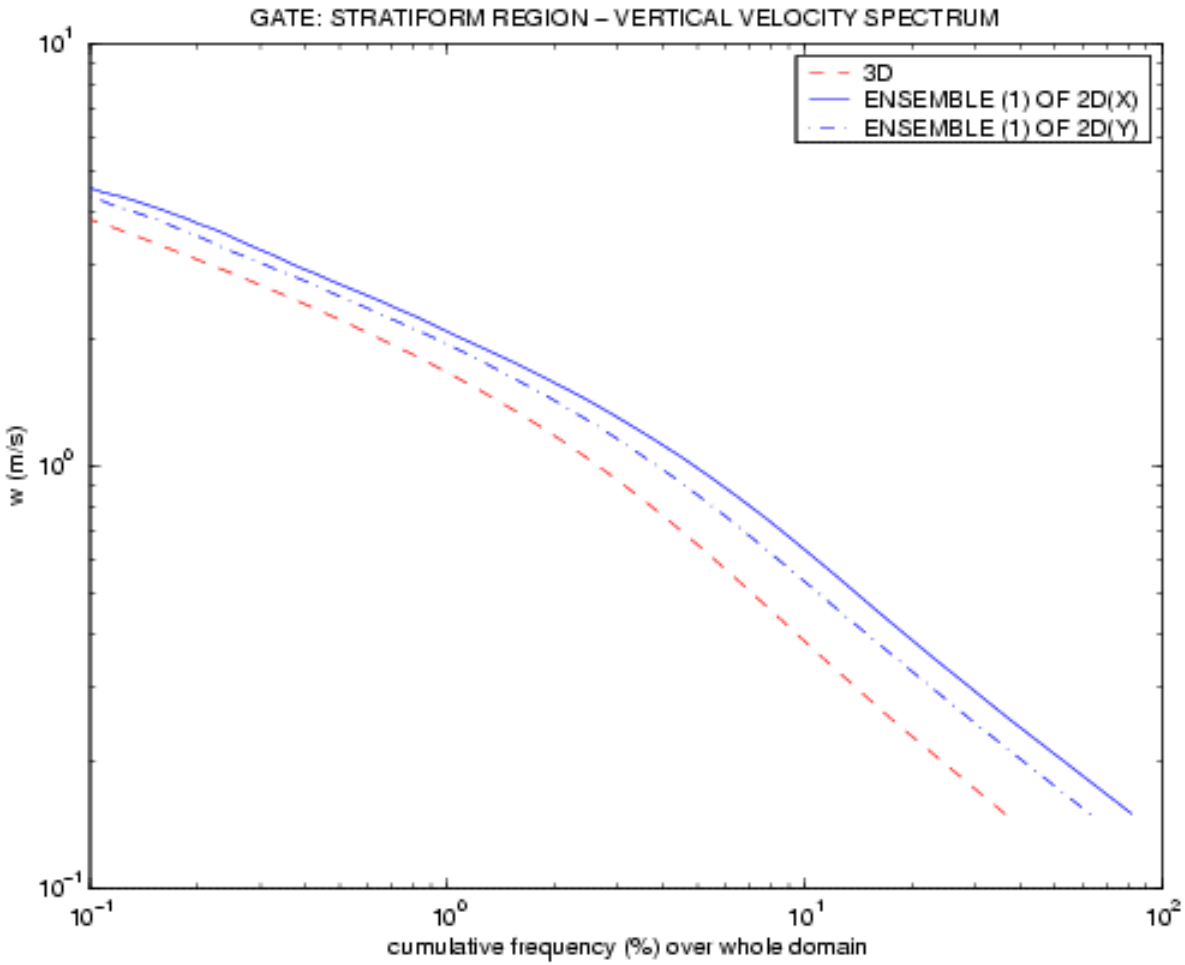

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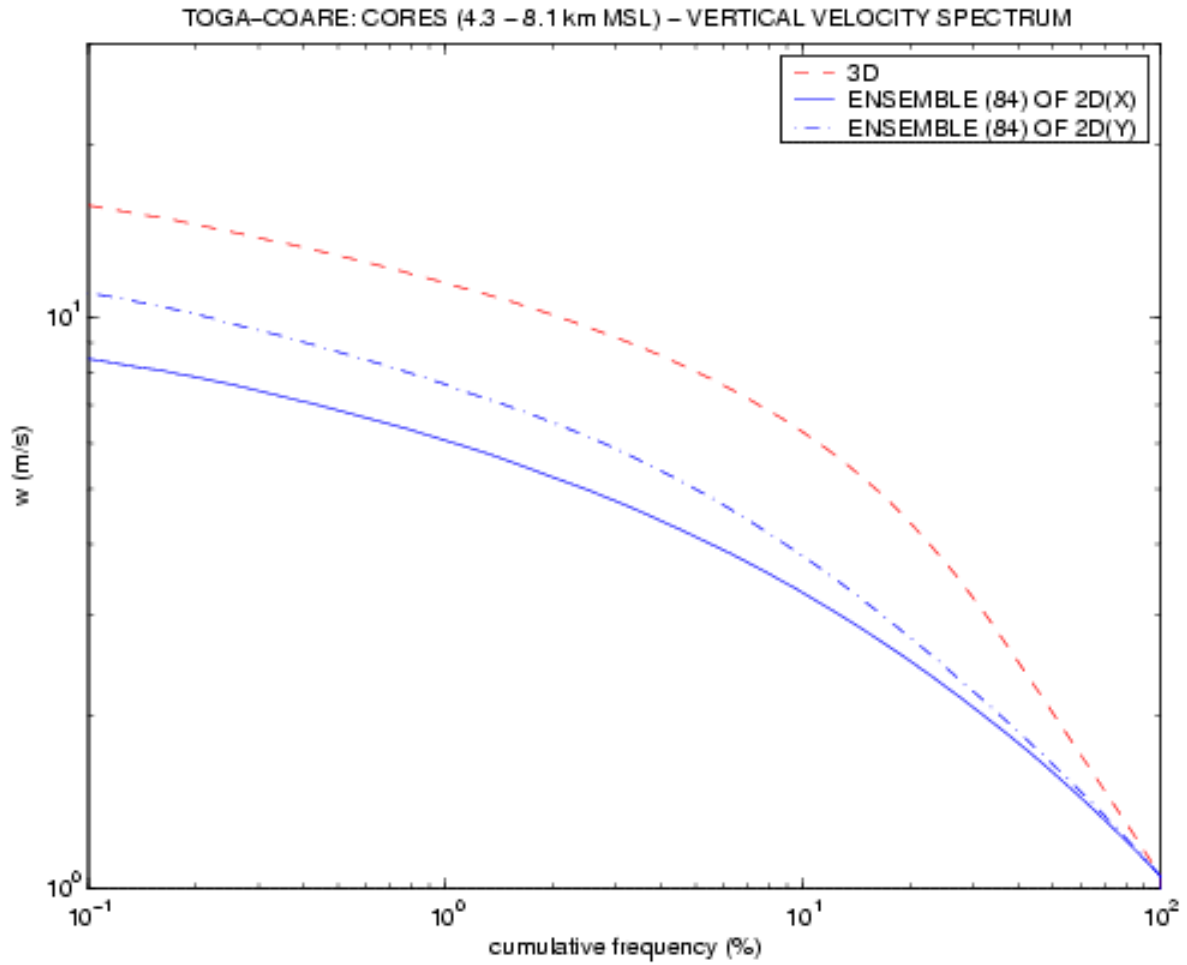

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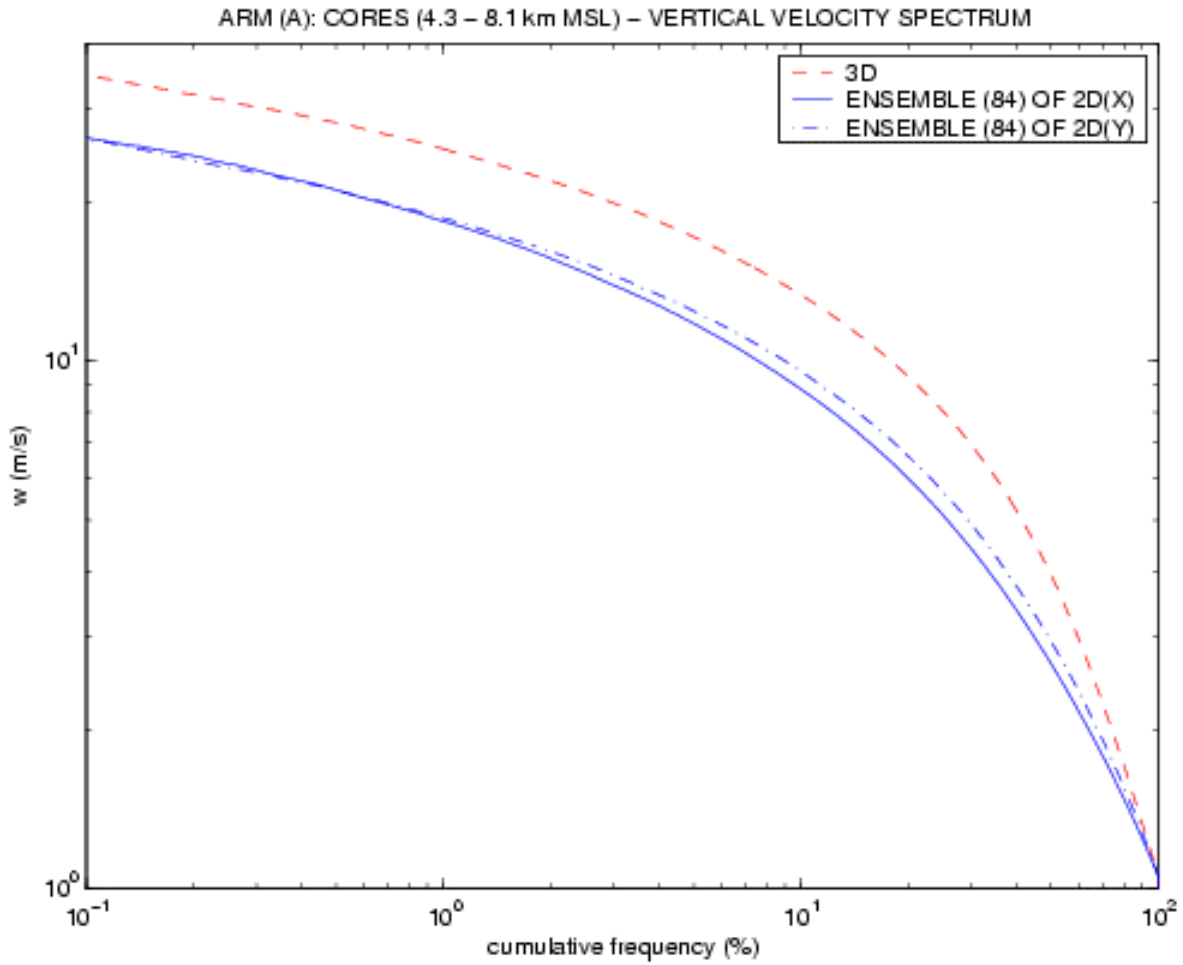

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2D > 3D SW Reflection: Microphysical Aspects

- Less cloud liquid,cloud ice, and snow in 3D
- More graupel in 3D
- Behavior holds for GATE, TOGA-COARE, and ARM A
- Precipitating stratiform fractional area less in 3D in all cases except ARM A 2D(y)
- Microphysics linked to convective vertical velocities, which differ sharply in 2 and 3D

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2D > 3D SW Reflection: Dynamic Aspects

- Cumulus vertical velocities higher in 3D than 2D for GATE, TOGA-COARE, ARM
- Convective mass flux greater in 3D than 2D for GATE and TOGA-COARE, and, for vertical velocities > 5 m s^{-1}, for ARM A
- Stratiform mass flux less in melting layer for GATE, ARM, and TOGA-COARE

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